

APTD - 0830

PB 207 698

**SALT LAKE CITY - PROVO - OGDEN
METROPOLITAN AREA
AIR POLLUTANT EMISSION INVENTORY**

*Details of illustrations in
this document may be better
studied on microfiche*



**U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service**

Reproduced by
**NATIONAL TECHNICAL
INFORMATION SERVICE**
Springfield, Va. 22151

63

R

BIBLIOGRAPHIC DATA SHEET		1. Report No. APTD-0830	2.	3. Recipient's Accession No.	
4. Title and Subtitle Salt Lake City - Provo - Ogden Metropolitan Area Air Pollutant Emission Inventory				5. Report Date February 1970	
				6.	
7. Author(s) David V. Mason				8. Performing Organization Rept. No.	
9. Performing Organization Name and Address U. S. Department of Health, Education, and Welfare National Air Pollution Control Administration Division of Air Quality and Emission Data Durham, North Carolina				10. Project/Task/Work Unit No.	
				11. Contract/Grant No.	
12. Sponsoring Organization Name and Address Same				13. Type of Report & Period Covered	
				14.	
15. Supplementary Notes					
16. Abstracts A summary is presented of the emission inventory for the Salt Lake City Metropolitan area. The report provides estimates of the present levels of air pollutant emissions and status of their control. The pollutants which include sulfur oxides, particulates, carbon monoxide, hydrocarbons, and nitrogen oxides are delineated with respect to source type, season of the year and geographical distribution within the area. The Study Area which was chosen on the basis of the distribution of population and air pollution sources, consists of seven counties surrounding the cities of Salt Lake City, Provo and Ogden. A grid coordinate system was used to show the geographical distribution of emissions within counties. All sources of emissions were classified into five categories: transportation, stationary fuel combustion, solid-waste disposal, industrial processes and evaporative losses.					
17. Key Words and Document Analysis. 17a. Descriptors Air pollution Transportation Emission Waste disposal Inventories Fuels Sulfur oxides Industrial plants Particles Evaporation Carbon monoxide Hydrocarbons Nitrogen oxides Seasonal variations Sources					
17b. Identifiers/Open-Ended Terms Salt Lake City - Provo - Ogden Provo, Utah Ogden, Utah Particulates Stationary sources					
17c. COSATI Field/Group 13B					
18. Availability Statement Unlimited				19. Security Class (This Report) UNCLASSIFIED	
				20. Security Class (This Page) UNCLASSIFIED	
				21. No. of Pages 59	
				22. Price	

SALT LAKE CITY, PROVO, AND OGDEN METROPOLITAN
AREA AIR POLLUTANT EMISSION INVENTORY

Prepared by
David V. Mason

*Details of illustrations in
this document may be better
studied on microfiche*

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Environmental Health Service
National Air Pollution Control Administration
Division of Air Quality and Emission Data
Durham, North Carolina
February, 1970

PREFACE

This report, which presents the emission inventory for the Salt Lake City Metropolitan Area, is another in a series of surveys outlining the sources and emissions of air pollutants for major metropolitan areas in the country. These surveys, conducted by the National Inventory of Air Pollutant Emissions and Control Branch of the National Air Pollution Control Administration, provide estimates of the present levels of air pollutant emissions and status of their control. The pollutants, which include sulfur oxides, particulates, carbon monoxide, hydrocarbons and nitrogen oxides, are delineated with respect to source type, season of the year and geographical distribution within the area. The general procedure for the surveys is based upon the rapid survey technique for estimating air pollutant emissions.¹ These reports are intended to serve as aids in the proposing of boundaries of Air Quality Control Regions, as directed by the Air Quality Act of 1967.

ACKNOWLEDGMENTS

Sincere gratitude is extended by the National Air Pollution Control Administration to the many individuals and companies who contributed to this air pollution emission inventory.

Special thanks are extended to Grant S. Winn, Director and Casper A. Nelson of the Air Pollution Section of the Utah State Division of Health, who contributed invaluable assistance in the gathering of data for this report.

TABLE OF CONTENTS

	Page
Introduction.....	1
Summary of Results.....	3
Description of Study Area.....	5
Grid Coordinate System.....	12
Emissions by Category.....	15
Stationary Fuel Combustion.....	15
Steam-Electric.....	15
Industrial.....	15
Residential.....	16
Commercial-Institutional.....	20
Transportation.....	21
Road Vehicles.....	22
Aircraft.....	24
Railroads.....	27
Solid Waste Disposal.....	27
Industrial Process Losses.....	28
Evaporative Losses.....	31
Emissions by Jurisdiction.....	34
Emissions by Grid.....	42
References.....	54

LIST OF TABLES

Table		Page
1	Summary of Air Pollutant Emission in Study Area.....	4
2	Area and Population Characteristics for Study Area.....	8
3	Number of Industrial Establishments in Study Area.....	11
4	Annual Fuel Consumption for Study Area.....	17
5	Chemical Analysis of Fuel Burned in Study Area.....	18
6	Air Pollutant Emissions from Fuel Combustion in Stationary Sources.....	19
7	Vehicle Miles of Travel for Road Vehicles.....	23
8	Air Traffic Activity at Salt Lake City International Airport and Hill Air Force Base.....	25
9	Air Pollutant Emissions from Transportation Sources.....	26
10	Solid Waste Disposal Balance.....	29
11	Air Pollutant Emissions from Solid Waste Disposal.....	30
12	Air Pollutant Emissions from Industrial Processes.....	32
13	Hydrocarbon Emissions from Evaporative Losses.....	33
14	Summary of Air Pollutant Emissions in Box Elder County.....	35
15	Summary of Air Pollutant Emissions in Cache County.....	36
16	Summary of Air Pollutant Emissions in Davis County.....	37
17	Summary of Air Pollutant Emissions in Salt Lake County.....	38
18	Summary of Air Pollutant Emissions in Tooele County.....	39
19	Summary of Air Pollutant Emissions in Utah County.....	40
20	Summary of Air Pollutant Emissions in Weber County.....	41
21	Summary of Air Pollutant Emissions from Point Sources.....	44
22	Summary of Air Pollutant Emissions from All Sources.....	46

LIST OF FIGURES

Figure		Page
1	Map of Salt Lake City, Provo and Ogden Study Area and Surrounding States.....	6
2	Detailed Map of Salt Lake City, Provo and Ogden Study Area.....	7
3	Population Density Map of Salt Lake City, Provo and Ogden Study Area.....	9
4	Grid Coordinate System for Salt Lake City, Provo and Ogden Study Area.....	13
5	Point Source Locations.....	43
6	Sulfur Oxides Emissions Density Map.....	49
7	Particulate Emission Density Map.....	50
8	Carbon Monoxide Emission Density Map.....	51
9	Hydrocarbon Emission Density Map.....	52
10	Nitrogen Oxide Emission Density Map.....	53

INTRODUCTION

This report is a summary of the Salt Lake City area air pollutant emission inventory conducted in August, 1969. Since all inventories are based upon a calendar year, the data and emission estimates presented are representative of 1968 and should be considered as indicating the conditions as existed during that year.

The Study Area, which was chosen on the basis of the distribution of population and air pollution sources, consists of seven counties surrounding the cities of Salt Lake City, Provo and Ogden. This area covers approximately 11,800 square miles and had a 1968 population of 910,000.

A grid coordinate system was used to show the geographical distribution of emissions within counties. The Study Area was subdivided into 51 grid zones ranging in size from 25 square kilometers in the heavily populated and industrialized areas to 400 square kilometers in the rural areas.

All sources of emissions were classified into five categories--transportation, stationary fuel combustion, solid-waste disposal, industrial processes and evaporative losses. Each of these source categories was divided into two subgroups--point sources and area sources. Facilities, which emit large quantities of air pollutants, were considered individually as point sources, while the many remaining contributors such as motor vehicles, residential and commercial fuel users, small industries and on-site refuse burning equipment were considered collectively as area sources. For this report, 31 individual sources, which had emissions greater than 0.25 tons per average annual day for any pollutant, were classified as point sources.

Emissions were estimated by using various indicators such as fuel consumption, refuse burning rates, vehicle-miles, production data, control efficiencies and emission factors relating these indicators to emission rates.² These factors represent average emission rates for

a particular source category. Since individual sources have inherent differences that cannot always be taken into consideration, discrepancies between the actual and estimated emissions are more likely in individual sources than in the total emissions for a source category.

As in all emission surveys, the data presented are estimates and should not be interpreted as absolute values. The estimates are, in some cases, partial totals due to the lack of emission factors and production or consumption data. Despite these limitations, the estimates are of sufficient accuracy and validity to define the extent and distribution of air pollutant emissions in the Study Area.

SUMMARY

An estimated 0.7 million tons of five major pollutants are emitted annually in the Study Area. The breakdown of these emissions by type of pollutant and source category are summarized in Table 1. The following is a presentation of the relative contribution of different source categories.

Sulfur Oxides	1968 Total - 260,300 tons
	Industrial Processes 89%
	Steam Electric 4%
	Industrial Fuel Use 3%
	Other 4%

Particulates	1968 Total - 60,500 tons
	Industrial Processes 61%
	Solid Waste Disposal 16%
	Stationary Fuel Use 14%
	Transportation 9%

Carbon Monoxide	1968 Total - 290,200 tons
	Road Vehicles 64%
	Solid Waste Disposal 16%
	Industrial Processes 15%
	Other 5%

Hydrocarbons	1968 Total - 54,000 tons
	Road Vehicles 28%
	Solid Waste Disposal 25%
	Evaporative Losses 21%
	Industrial Processes 12%
	Aircraft & Railroads 9%
	Other 5%

Nitrogen Oxides	1968 Total - 48,800 tons
	Industrial Fuel Use 28%
	Road Vehicles 23%
	Aircraft & Railroads 16%
	Solid Waste Disposal 11%
	Steam Electric 10%
	Other 12%

TABLE 1 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE SALT LAKE
CITY, PROVO, AND OGDEN STUDY AREA, 1968 (TONS/YEAR)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Road Vehicles	1,000	1,800	185,400	15,000	11,200
Other	2,800	3,800	10,300	6,100	7,900
Totals	3,800	5,600	195,700	21,100	19,100
Fuel Combustion in Stationary Sources					
Industry	8,900	2,200	100	100	13,400
Steam-Electric	10,700	1,500	0	100	4,900
Residential	900	700	1,300	300	2,200
Commercial- Institutional	2,700	3,900	5,500	1,100	2,800
Totals	23,200	8,300	6,900	1,600	23,300
Solid Waste Disposal					
Incineration	500	2,600	7,900	200	600
Open Burning	400	7,100	37,600	13,300	4,900
Totals	900	9,700	45,500	13,500	5,500
Industrial Processes	232,400	36,900	42,100	6,500	900
Evaporative Losses				11,300	
STUDY AREA	260,300	60,500	290,200	54,000	48,800

DESCRIPTION OF STUDY AREA

The Study Area for the Salt Lake City, Provo, and Ogden Metropolitan Area Air Pollutant Emission Inventory covers the northwest corner of the State of Utah. As can be seen in Figure 1, the Study Area is a considerable distance from other metropolitan areas.

The seven counties included in the Study Area (Figure 2) are: Box Elder County, Cache County, Davis County, Salt Lake County, Tooele County, Utah County, and Weber County. Four of the counties are in designated Standard Metropolitan Statistical Areas (SMSA). These SMSA's include: Salt Lake City SMSA (Salt Lake County and Davis County), Provo SMSA (Utah County), and Ogden SMSA (Weber County). Box Elder County, Cache County and Tooele County were included to insure that all counties which may have a high rate of growth in future years are in the Study Area.

The approximate 1968 population for the Study Area was 910,000. Although the area is 11,800 square miles, the majority of the people live in an urbanized area of only 240 square miles (1960). Table 2, which gives populations by county, and Figure 3, which is a population density map, show that most of this urbanized area is in Fulton County. The population in the seven county area has increased at a quicker pace than in the nation as a whole. Between 1960 and 1968, the nation's population increased 10.9 percent, and the Salt Lake City Study Area increased 17.4 percent.

TOPOGRAPHY

The Study Area is made up of a series of valleys which lie along the west base of the Wasatch Mountains. The populated sections of the Study Area lie in these valleys which make up an area about 100 miles long and 10 miles wide between two natural boundaries. To the east, only a few miles from Salt Lake City, the Wasatch Mountains rise 4,000 to 6,000 feet. To the west lie Great Salt Lake, Utah Lake and the Great Salt Lake Desert.



Figure 1. Map of Salt Lake City, Provo, and Ogden study area and surrounding states.



Figure 2. Detailed map of the Salt Lake City, Provo, and Ogden study area.

TABLE 2 AREA AND POPULATION CHARACTERISTICS FOR THE SALT LAKE
CITY, PROVO, AND OGDEN STUDY AREA

County	Land Area (sq. mi.)	Population		Population Density (1968)
		1960	1968	
Box Elder County	5,627	25,061	29,100	5
Cache County	1,174	35,788	43,800	37
Davis County	297	64,760	95,300	321
Salt Lake County	1,023	383,035	457,700	447
Tooele County	6,923	17,868	22,300	3
Utah County	2,014	106,991	133,800	66
Weber County	581	110,744	127,500	219
STUDY AREA	17,639	774,247	909,500	52

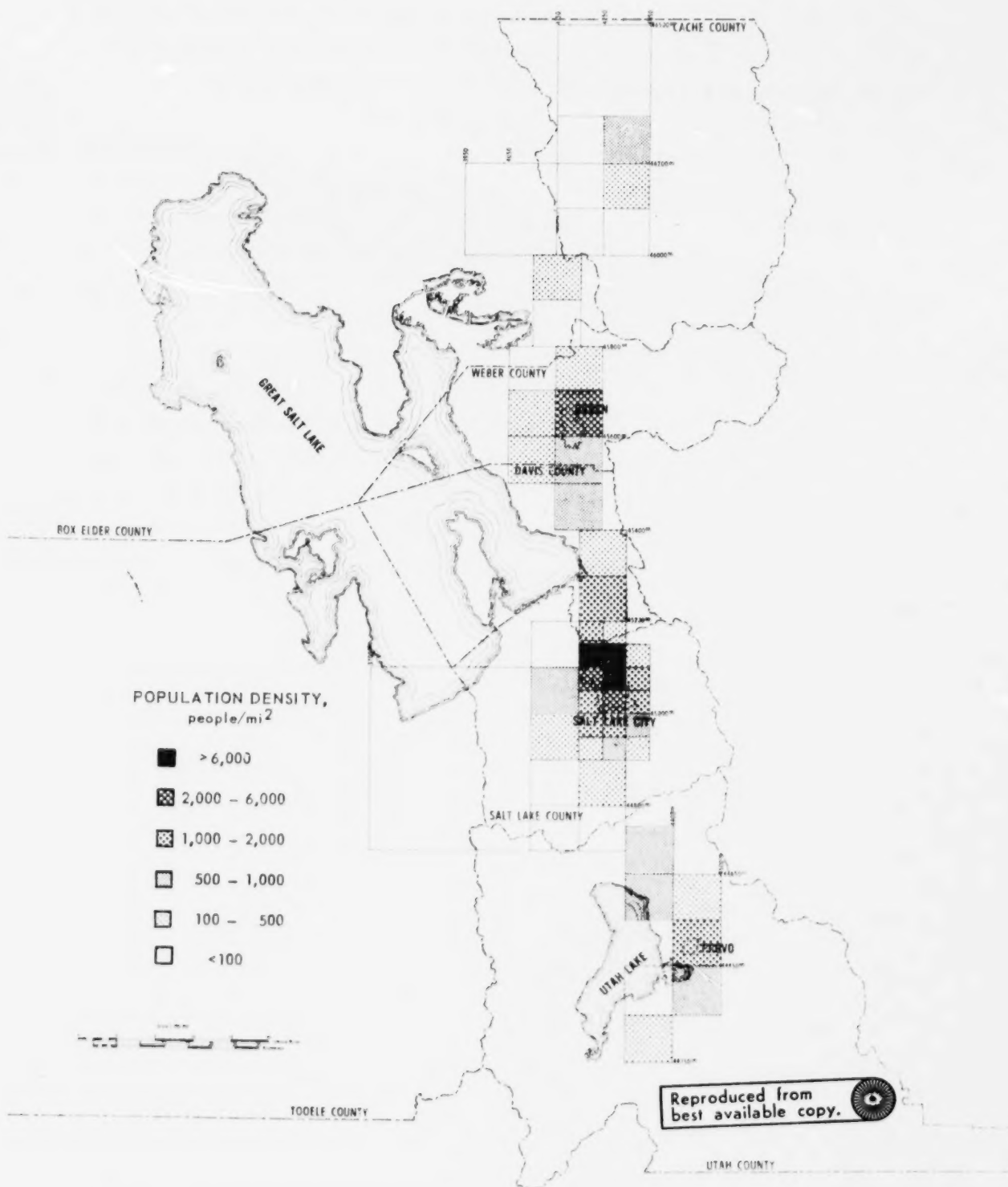


Figure 3. Population density map for the Salt Lake City, Provo, and Ogden study area.

CLIMATOLOGY

The Salt Lake City area is considered a semi-arid continental climate with four well-defined seasons. Summers are characterized by hot, dry weather with maximum reading most days in the nineties. Winters are cold, but usually not severe.

Aside from the altitude and the Great Salt Lake, the most influential natural condition affecting the climate is the Wasatch Mountains. Due to the proximity of the mountain range, about five inches more precipitation per year can be expected along the eastern edge of the Study Area than over the valley a few miles to the west.

INDUSTRIAL FACTORS

The Study Area has a variety of industry, as can be seen in Table 3. The heavy industry in the Study Area comprises one steel mill, four large oil refineries and several smelters. Also included in the Study Area are foundries, woodworking facilities, concrete batching plants, brick manufacturers, chemical plants, asphaltic concrete batch plants and paint manufacturers.

TABLE 3 NUMBER OF INDUSTRIAL ESTABLISHMENTS IN THE SALT LAKE
CITY, PROVO, AND OGDEN STUDY AREA, 1960

	Box Elder County	Cache County	Davis County	Salt Lake County	Tooele County	Utah County	Weber County
Food and Tobacco	2	8	6	47	--	4	23
Textiles	2	2	--	8	--	4	3
Paper and Printing	1	1	1	19	--	2	4
Chemicals	1	--	3	12	1	3	1
Lumber and Wood	--	--	--	15	--	--	2
Stone and Gravel	2	1	--	16	2	6	5
Primary and Inter- mediate Metals	--	1	--	31	2	10	4
Electrical Machinery	--	1	1	18	--	1	3
Transportation and Ordinance	1	1	1	5	1	1	1
Instruments and Miscellaneous	--	--	--	9	--	--	3

GRID COORDINATE SYSTEM

A grid coordinate system, based on the Universal Transverse Mercator Projection (UTM), was used in the Salt Lake City Study Area to indicate the geographical distribution of emissions. A map showing the grid coordinate system is presented in Figure 4.

An evaluation of the available coordinate systems was completed before choosing the UTM system to present emissions in this series of emission inventories. The systems evaluated were the State Plane system, the Longitude-Latitude system and the UTM system. Although each of the systems had valuable qualities, the use of the UTM coordinate system was felt to completely meet the requirements of these emission inventories.

Two primary requirements of the grid coordinate system were used to evaluate each system. One of the requirements was that the grid coordinate system had to have square grid zones, since the data were to be used in meteorological dispersion models. The grid zones, which the UTM system and most of the State Plane systems project, are always square, but the longitude-latitude system projects grid zones that become skewed as the zones become further from the equator. The other quality the grid coordinate system had to possess was consistency. Each emission inventory should be conducted on a grid coordinate system which uses the same reference point throughout the Study Area. Since some air pollutant inventories would include areas in two or more states, the State Plane systems could not be used. However, since the UTM system, as well as the longitude-latitude system, is not referenced to points in individual states, it is not influenced by jurisdiction boundaries. The UTM system was chosen since it was the only coordinate system which could project square grid zones over any Study Area using a common reference point.

The Universal Transverse Mercator Projection is based upon the metric system. Each north-south and east-west grid lines, as illustrated

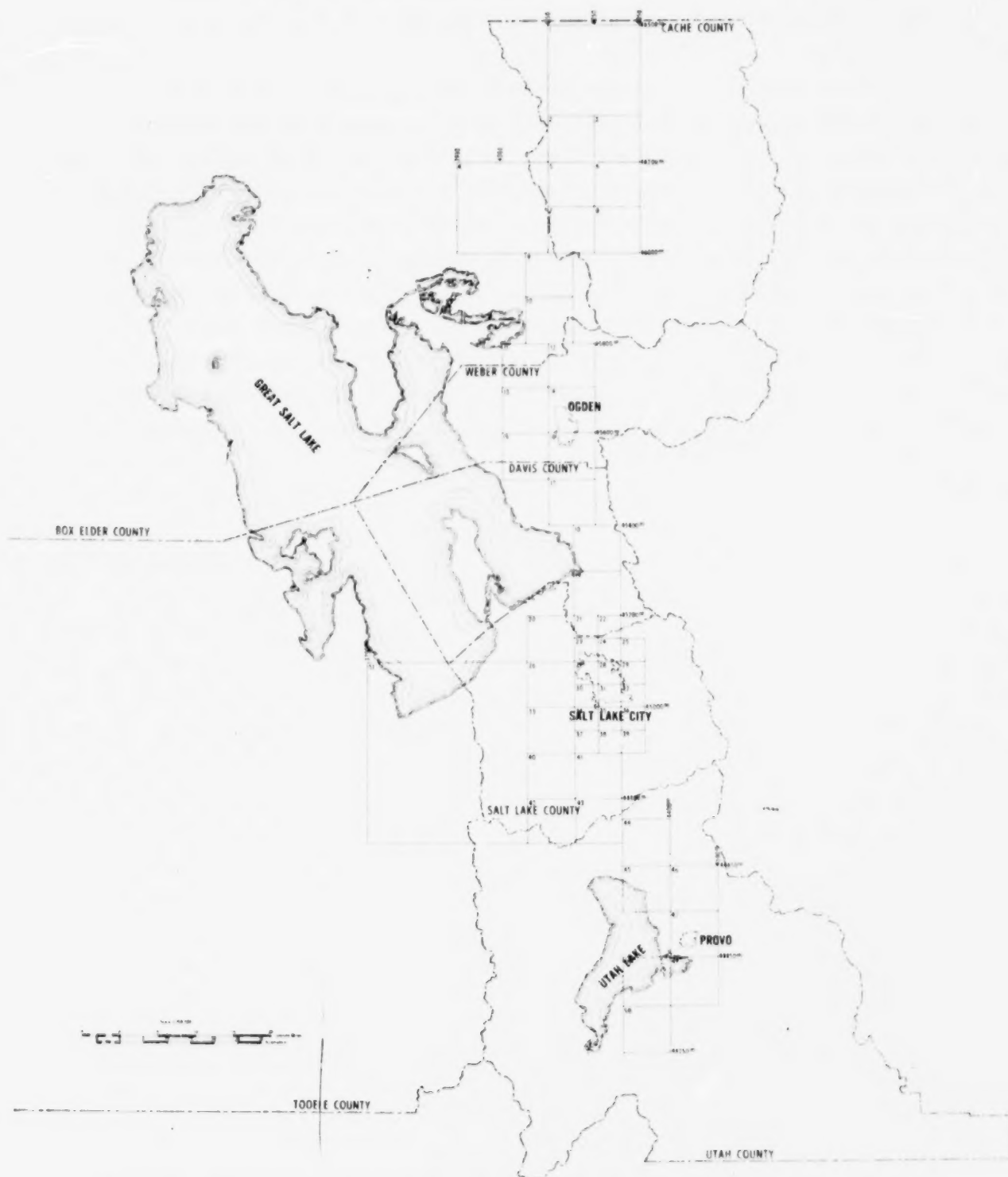


Figure 4. Grid coordinate system for the Salt Lake City, Provo, and Ogden study area.

in Figure 4, is identified by a coordinate number expressed in meters. Each point source and grid, using the geographical center of the grid, is identified by a horizontal and vertical coordinate to the nearest 100 meters.

Grid zones of different sizes are used in the grid coordinate system to allow a satisfactory definition of the geographical gradation of emissions and to limit the number of grid zones. Since majority of the emissions is usually concentrated in the populated and industrialized portions of a Study Area, smaller grids are placed over these areas to allow the grid coordinate system to reflect the changes of emissions over short distances. Grid zones smaller than the 25 kilometer grid zones used in this report are not usually warranted because of the inherent inaccuracies in the data. Larger grid zones are used in the rural portions, because a smaller portion of the total emissions usually occurs in lightly populated areas.

STATIONARY FUEL COMBUSTION

The stationary fuel combustion source category is concerned with four primary sources: industrial facilities, steam-electric plants, residential housing, and commercial and institutional establishments. Four fuels are usually burned in these sources: coal, residual fuel oil, distillate fuel oil and natural gas. Other fuels such as woodwaste and LPG are also included if there is a sufficient amount being burned.

Steam-Electric

METHODOLOGY: Fuel consumption data were acquired from the various power companies in the Study Area by the State Air Pollution Section through personal communications. Data received on seven power plants included the monthly fuel consumption for 1968, type and efficiency of control equipment, sulfur and ash content of the fuel, and the type of furnace, if coal was being burned.

RESULTS: Steam-electric power plants in the Study Area burn four fuels: residual fuel oil, distillate fuel oil, natural gas and coal. Although most of the smaller power plants burn coal, 92 percent of the energy generated comes from natural gas and fuel oil. The one large power plant located in Salt Lake County consumes 100 percent of the residual fuel oil and 90 percent of the natural gas.

The sulfur oxide emissions, particulate emissions and nitrogen oxide emissions are the major pollutants caused by steam-electric power plants. Power plants account for 46 percent of the sulfur oxides, 18 percent of the particulates and 21 percent of the nitrogen oxides emitted by stationary fuel combustion.

Industry

METHODOLOGY: Fuel consumption data were obtained for more than 75 large industries in the Study Area. Although some of this data were received from fuel associations, most of the data were obtained by the State Air Quality Section by personally contacting each company.

In order to approximate the balance of the fuel being burned in the Study Area, the following fuel associations and fuel dealers were asked to supply total industrial fuel consumption by county: the Utah-Wyoming Coal Association, the Utah Petroleum Council, and the Mountain Fuel Supply Company.

It should be noted that fuel combustion by industries includes both fuel used for space heating, which varies from season to season, and fuel used for process heating, which is considered constant all year around. The individual sources were asked to differentiate between fuel used for process and fuel used for space heating. A national average was used to delineate process heating from space heating in the area sources.

RESULTS: Five fuels are burned by industry in the Study Area: residual fuel oil, distillate fuel oil, natural gas, refinery gas and coal. Residual fuel oil and natural gas, the most significant fuels, together generate approximately 90 percent of the energy used by industry. Table 4 shows the approximate consumption of these fuels by county.

The large quantities of residual fuel oil and natural gas burned by industry attribute to the larger amounts of sulfur oxides and nitrogen oxides being emitted than the other three pollutants (Table 6). Fuel consumption by industries accounts for 64 percent of the nitrogen oxides and 25 percent of the sulfur oxides emitted by stationary fuel combustion. Industry emits lesser proportions of the other three pollutants.

Residential

METHODOLOGY: Natural gas consumption data received from the Mountain Fuel Supply Company included both residential and commercial usage in the same category. A mathematical method of calculating residential fuel consumption, which uses the number of housing units burning gas, was used to separate the two categories.¹ The number of housing units burning natural gas in 1968 was obtained by increasing the 1960 county totals³ by the same percent the sales increased in the Mountain Fuel Supply Company's residential-commercial category.

TABLE 4 ANNUAL FUEL CONSUMPTION FOR THE SALT LAKE CITY,
PROVO, AND OGDEN STUDY AREA, 1968

County	Industrial	Commercial- Institutional	Residential	Steam-Electric Utilities
<u>Natural Gas</u> (10 ⁶ cu.ft./yr.)				
Box Elder County	800	400	700	0
Cache County	1,300	500	1,300	0
Davis County	3,700	4,800	3,500	100
Salt Lake County	25,500	13,200	17,400	5,800
Tooele County	1,000	800	600	0
Utah County	19,200	2,400	4,500	500
Weber County	2,500	2,800	4,600	0
Total	54,000	24,900	32,600	6,400
<u>Distillate Fuel Oil</u> (1000 gal./yr.)				
Box Elder County	0	200	400	0
Cache County	0	200	700	0
Davis County	0	200	800	100
Salt Lake County	1,800	1,700	5,100	100
Tooele County	0	200	600	0
Utah County	1,600	2,600	4,100	0
Weber County	0	400	1,200	0
Total	3,400	5,500	12,900	200
<u>Residual Fuel Oil</u> (1000 gal./yr.)				
Box Elder County	0	0	0	0
Cache County	100	0	0	0
Davis County	2,700	0	0	0
Salt Lake County	13,500	0	0	59,700
Tooele County	0	100	0	0
Utah County	27,000	0	0	0
Weber County	100	0	0	0
Total	43,400	100	0	59,700
<u>Coal</u> (tons/year)				
Box Elder County	0	18,000	4,700	0
Cache County	0	25,000	7,400	0
Davis County	0	16,000	2,600	16,500
Salt Lake County	23,000	84,000	19,700	24,800
Tooele County	0	5,400	600	0
Utah County	3,000	52,000	10,000	16,700
Weber County	0	21,000	6,600	0
Total	26,000	221,400	51,600	58,000

TABLE 5 CHEMICAL ANALYSIS OF FUELS BURNED IN THE SALT LAKE
CITY, PROVO, AND OGDEN STUDY AREA

	Percent Sulfur	Percent Ash	Percent Volatile
Coal	0.6	7.1	41.2
Residual Fuel Oil	2.09		
Distillate Fuel Oil	0.32		
Natural Gas	0.0008		

TABLE 6 ' AIR POLLUTANT EMISSIONS FROM FUEL COMBUSTION IN
STATIONARY SOURCES IN THE SALT LAKE CITY, PROVO AND
OGDEN STUDY AREA, 1968 (TONS/YEAR)

	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Natural Gas					
Industrial	0	1,000	0	0	11,400
Steam-Electric	0	0	0	0	1,300
Residential	0	300	0	0	1,900
Commercial- Institutional	0	200	0	0	1,400
Total	0	1,500	0	0	16,000
Fuel Oil					
Industrial	4,400	500	0	0	1,700
Steam-Electric	10,000	300	0	100	3,100
Residential	300	100	0	0	100
Commercial- Institutional	200	0	0	0	200
Total	14,900	900	0	100	5,100
Coal					
Industrial	300	700	0	0	300
Steam-Electric	700	1,200	0	0	600
Residential	600	400	1,300	300	200
Commercial- Institutional	2,500	3,600	5,500	1,100	900
Total	4,100	5,900	6,800	1,400	2,000
STUDY AREA	19,000	8,100	6,800	1,500	21,100

Accurate oil consumption data on residential users were not available from any companies or associations. It was assumed that all the distillate oil sold in counties, which had been obtained from the Utah Petroleum Council, was being burned in residential or commercial sources. This did not include that distillate oil already assigned to individual industrial sources. Based upon past inventories, it was estimated that residential usage was three times that of commercial usage.

Coal consumption was obtained in much the same manner natural gas consumption was. The same mathematical method was used. The number of housing units burning coal in 1968 was determined by assuming a decrease of 50 percent had occurred since 1960.

Fuel burned in homes is used for more than just space heating. A certain portion of the fuel is used for such heating purposes as cooking and hot water heating, which remain constant throughout the year. It was estimated that fifteen percent of the natural gas, 5 percent of the oil and two percent of the coal was used for these purposes.

RESULTS: Natural gas is the major fuel used to heat homes in the Salt Lake City, Provo and Ogden Study Area. Over 90 percent of the home heating energy comes from natural gas. The two other fuels are burned in the rural areas of the Study Area.

Emissions caused by residential fuel combustion are relatively low in all pollutants, but because coal is not too efficiently burned in homes, carbon monoxide and particulates are higher than might be expected. None of the pollutants contribute more than 19 percent of the stationary fuel combustion emissions.

Commercial-Institutional

METHODOLOGY: Fuel consumption in the commercial-institutional source category is usually highly dependent upon the amount of residential fuel consumption. A portion of the natural gas consumption for commercial establishments was obtained by subtracting the calculated residential gas figures from the residential-commercial data received from the

Mountain Fuel Supply Company. The remaining natural gas consumption was attributed to individual commercial sources that the Mountain Fuel Supply Company had placed in the industrial category because they were very large. Distillate fuel oil consumed by commercial sources was also determined by subtracting the residential figures from the total fuel consumption data. Comprehensive coal usage data were received from the Utah-Wyoming Coal Association for the commercial category.

Commercial fuel consumption was proportioned into grids both on an individual and area source basis. Natural gas and distillate fuel oil had a few individual sources, but were proportioned for the most part by population. Coal was proportioned by using the data on individual sources. Population had to be used to proportion only a small percentage of the commercial coal consumption.

RESULTS: Commercial-institutional establishments burn significant amounts of coal, distillate fuel oil, and natural gas. Over 60 percent of the coal consumed in the Study Area is burned in commercial or institutional establishments. But even with this proportionately high amount of coal being burned by this type source, natural gas is used to generate over 80 percent of the energy.

Emissions caused by the burning of these fuels are highest in carbon monoxide and hydrocarbons. Eighty percent of the carbon monoxide and 68 percent of the hydrocarbons emitted by stationary fuel combustion come from commercial and institutional sources. The other three pollutants emit the following portions of the total stationary fuel combustion emissions: sulfur oxides - 12 percent, particulates - 46 percent, and nitrogen oxides - 12 percent.

TRANSPORTATION

The transportation source category is concerned with mobile air pollutant sources. Sources in this category include: road vehicles (both gasoline and diesel powered), aircraft, vessels, and railroads. With the exception of aircraft, all the sources are considered area sources.

Road Vehicles

METHODOLOGY: In order to obtain the most accurate data on the motor vehicle activity in the Study Area, the Utah State Department of Highways was asked to supply the total vehicle-miles for each county.⁵ Unfortunately these totals did not include some of the motor vehicle activity in the urbanized portions of the Study Area. To supplement these totals, an attempt was made to locate comprehensive traffic flow maps of downtown Salt Lake City, Provo and Ogden. County gasoline consumption figures obtained from the U. S. Department of Commerce were finally used as the basis for the total vehicle miles driven in the Study Area.⁶ These gasoline consumption figures were updated to 1968 by using state vehicle mile data supplied by the U. S. Department of Transportation.⁷

The proportioning of the county vehicle mile data into grids was completed using two methods. The first method utilized traffic flow maps obtained from the State Highway Department. The grid coordinate system was drawn over the maps and the vehicle miles on the major streets and roads were measured for their respective grids. A second method used the population of each grid as the basis of proportioning the vehicle miles. Only those vehicle miles left undistributed by the first method were proportioned by population.

Accurate diesel powered motor vehicle activity was obtained from state diesel fuel consumption figures.⁷ These fuel numbers were translated into vehicle miles by assuming all diesel powered vehicles averaged 5.1 miles per gallon.¹ The state totals were proportioned into the counties by using the state to county ratios obtained from the gasoline consumption calculations. Diesel powered vehicle miles were proportioned only into those grids which had major highways and roads within their borders.

Emission controls were taken into consideration when automobile emissions were calculated. The efficiency of control and the age and variety of automobiles were based upon national averages.

RESULTS: Vehicle activity in the Study Area was greatest in the four more urban counties. The number of vehicle miles traveled can be

TABLE 7 VEHICLE MILES OF TRAVEL FOR ROAD VEHICLES IN THE
SALT LAKE CITY, PROVO, AND OGDEN STUDY AREA, 1968
(1000 v.m./year)

Jurisdiction	Gasoline Powered Road Vehicles	Diesel Powered Road Vehicles	Total
Box Elder County	94,100	3,500	97,600
Cache County	119,100	4,400	123,500
Davis County	136,700	5,100	141,800
Salt Lake County	1,172,200	43,800	1,216,000
Tooele County	66,700	2,500	69,200
Utah County	325,800	12,200	338,000
Weber County	306,600	11,400	318,000
STUDY AREA	2,221,200	82,900	2,304,100

seen in Table 7. Davis County, Salt Lake County, Utah County and Weber County accounted for about 87 percent of the total vehicle activity in the Study Area. Salt Lake County alone had over 50 percent of the traffic. Gasoline consumption and air pollutant emissions are distributed among the counties in similar proportions.

Road vehicles, a major contributor of three of the pollutants surveyed, were the dominant source within the transportation source category. They contributed 95 percent of the carbon monoxide, 80 percent of the hydrocarbons and 60 percent of the nitrogen oxides. Sulfur oxides and particulates were emitted but to a lesser degree when compared to the other transportation sources. When compared to all sources in the Study Area, road vehicles ranked number one in amount of carbon monoxide and hydrocarbon emitted and number two in nitrogen oxide emissions (Table 1).

Aircraft

METHODOLOGY: Data were obtained for two airports in the Study Area: Salt Lake City International Airport and Hill Air Force Base. The data received included number of flights per day and number and type of engines per flight. This information was collected by the State Air Pollution Section by personal communication with each airport. Information was not secured on the small private airports in the Study Area, because accurate information was not available.

RESULTS: The major portion of aircraft activity in the Study Area was at the Salt Lake City International Airport (Table 8). Numerous commercial flights come into the airport each day, and large numbers of private and business aircraft operate from the field. Although the Hill Air Force Base has fewer flights on its field, the airport does contribute a substantial amount of air pollutants, since a large number of conventional jets operate on the field.

As can be seen in Tables 1 and 9, aircraft emissions account for a small portion of the total emissions in the transportation source category and in the Study Area. Within the transportation source category, aircraft

TABLE 8 AIR TRAFFIC ACTIVITY AT SALT LAKE CITY INTERNATIONAL
AIRPORT AND THE HILL AIR FORCE BASE, 1968
(FLIGHTS/YEAR)

	Number of Engines			
	1	2	3	4
Salt Lake City Airport				
Conventional Jet	0	0	0	0
Fan Jet	0	2,000	6,100	12,200
Turbo-prop	0	1,100	0	6,500
Piston	85,000	16,700	0	2,700
Hill Air Force Base				
Conventional Jet	800	7,200	0	700
Fan Jet	0	0	0	0
Turbo-prop	0	100	0	700
Piston	400	1,200	0	5,000

TABLE 9 AIR POLLUTANT EMISSIONS FROM TRANSPORTATION SOURCES IN
THE SALT LAKE CITY, PROVO, AND OGDEN STUDY AREA, 1968
(TONS/YEAR)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Road Vehicles					
Gasoline	700	900	184,900	13,900	9,400
Evaporative				9,300	
Diesel	300	900	500	1,100	1,800
Total	1,000	1,800	185,400	24,300	11,200
Aircraft					
Jet	0	100	200	300	100
Piston	0	0	8,200	1,600	400
Turbo-prop	0	0	0	0	0
Total	0	100	8,400	1,900	500
Railroads	2,800	3,600	1,900	4,300	7,200
STUDY AREA	3,800	5,500	195,700	30,500	18,900

contribute 6 percent of the particulates, 2 percent of the carbon monoxide, 18 percent of the hydrocarbons and 26 percent of the nitrogen oxides.

Railroads

METHODOLOGY: Information on the fuel consumption of railroads for the State of Utah was obtained from an American Petroleum Institute publication.⁸ These figures were proportioned into the Study Area and then into the individual counties on the basis of population. The county totals were proportioned into grids by evenly distributing the fuel into all grids which had railroad activity.

RESULTS: Emissions caused by railroads in the Study Area had a substantial effect on the amount of sulfur oxides and particulates contributed by the transportation source category. Railroads emitted 2,800 tons per year (73 percent) of the sulfur oxides and 3,600 tons per year (65 percent) of the particulates.

The emissions of sulfur oxides and particulates were less significant when compared to all sources in the Study Area. Railroads contributed about 1 percent of the sulfur oxides and 2 percent of the particulates emitted in the Study Area.

SOLID WASTE

The solid waste source category is concerned with the air pollutant emissions caused by refuse disposal. Refuse includes not only the municipal refuse, but also refuse generated by commercial and industrial facilities. The primary means of disposing of refuse are: landfills, dumps, incinerators, and on-site burning. Only open burning dumps, incinerators and on-site burning are considered air pollutant sources.

METHODOLOGY: The total tons of refuse generated in the Salt Lake City area was determined by using the national generation rate of 10 pounds per person per day.⁹ This total includes municipal, commercial and industrial refuse. In order to determine the amount of refuse being disposed of by each means of disposal, data was collected on all landfills, dumps and incinerators in the Study Area. The amount of refuse being disposed of by on-site incineration and on-site burning was determined

with national averages.¹² These data were assembled into a refuse balance (Table 10).

The proportioning of the county totals into grids was done in three steps. The first was the accurate locating of all incinerators and open-burning dumps which had been surveyed. The refuse being disposed of by the remaining open-burning dumps was proportioned evenly into the rural grids of each county. The on-site burning and on-site incineration were distributed into grids on the basis of population.

RESULTS: Emissions caused by the open burning of refuse, contributed most of the emissions in the solid waste source category (Table 11). Open burning emissions, which were evenly divided between open burning dumps and on-site burning, ranged from 45 percent of the sulfur oxides to 99 percent of the hydrocarbons.

The solid waste category when compared to the other emission sources in the Study Area ranked second in total tons emitted per year for carbon monoxide, particulates and hydrocarbons. Solid waste disposal was ranked third in nitrogen oxide emissions and was very low for sulfur oxides.

INDUSTRIAL PROCESSES

The industrial process category is concerned with all industrial air pollutant sources other than the burning of fuel or the disposal of refuse. That portion of fuel which is used for process heating is included in the fuel combustion source category.

METHODOLOGY: Information concerning industrial processes was gathered on an individual plant basis. Each company was contacted by the State Air Quality Section and asked to supply the appropriate data. Because of the tremendous cooperation in the Study Area, no engineering estimates had to be made on any industrial facilities. The emission rates from industrial processes were estimated by using standard emission factors published by the Department of Health, Education and Welfare.²

TABLE 10 SOLID WASTE DISPOSAL BALANCE FOR THE SALT LAKE CITY, PROVO, AND OGDEN
STUDY AREA, 1968 (TONS/YEAR)

Jurisdiction	Total Generations	Incineration			
		Municipal	On-Site	Landfill	Dump
Box Elder County	53,000				30,000
Cache County	80,000				45,000
Davis County	174,000		26,000		96,000
Salt Lake County	840,000		240,000	300,000	160,000
Tooele County	41,000				23,000
Utah County	244,000		37,000		135,000
Weber County	233,000	100,000	55,000		27,000
STUDY AREA	1,665,000	100,000	358,000	300,000	516,000
					391,000

TABLE 11 AIR POLLUTANT EMISSIONS FROM SOLID WASTE DISPOSAL
IN THE SALT LAKE CITY, PROVO, AND OGDEN STUDY
AREA, 1968 (TONS/YEAR)

	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Incineration					
Municipal	100	800	100	0	100
On-Site	400	1,800	7,900	100	500
Total	500	2,600	8,000	100	600
Open Burning					
Dumps	200	4,000	21,000	7,400	2,700
On-Site	200	3,100	16,600	5,900	2,200
Total	400	7,100	37,600	13,300	4,900
STUDY AREA	900	9,700	45,600	13,400	5,500

RESULTS: Air pollutant emissions were caused by only a few industrial processes in the Study Area. The industrial categories and emissions attributable to each are found in Table 12. The smelters emitted over 99 percent (231,000 tons) of the sulfur oxides and 52 percent (23,000 tons) of the carbon monoxide in the source category. These smelters alone accounted for 89 percent of the sulfur oxides and 8 percent of the carbon monoxide in the Study Area. The iron and steel mill did not emit much sulfur oxides in its industrial processes, but the 17,600 tons of particulates emitted are attributable for 46 percent of the particulates emitted in the source category and 29 percent of that emitted in the Study Area. Two other large industrial processes emissions categories are grey iron foundries and cement manufacturing. Grey iron foundries emitted 21,000 tons of carbon monoxide or almost as much as the smelters, and the cement manufacturers emitted only 3,000 tons of particulates less than the iron and steel mill. Other industries surveyed in the Study Area were petroleum refining, wood processing and asphaltic concrete manufacturing.

EVAPORATIVE LOSSES

The evaporative losses source category is concerned with emissions of hydrocarbons. The three primary sources studied in this category were dry cleaning, the automobile, and gasoline storage and handling. There are a multitude of other domestic and commercial sources of evaporative losses, but these were not included because emission factors were not available.

METHODOLOGY: Dry cleaning emissions and gasoline storage and handling emissions were estimated using factors based upon population.² The emissions were also proportioned into counties and grids using population. Evaporative losses by the automobile were estimated using vehicle mile activity. These emissions were distributed in the same manner that the balance of the automobile emissions were.

RESULTS: The automobile was the largest single source in the evaporative losses category with 9,300 tons of hydrocarbons (Table 13). Dry cleaning and gasoline storage and handling contributed 1,800 tons and 200 tons of hydrocarbons respectively. In the Study Area evaporative losses accounted for 21 percent of all hydrocarbons emitted.

TABLE 12 AIR POLLUTANT EMISSIONS FROM INDUSTRIAL PROCESS IN
THE SALT LAKE CITY, PROVO AND OGDEN STUDY AREA,
1968 (TONS/YEAR)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Petroleum Refining				6,400	400
Metal Industries					
Iron and Steel	1,700	17,600			500
Smelters	230,700	3,600	23,000		
Grey Iron Foundries		400	21,400		
Wood Products		100		100	
Mineral Products					
Asphaltic Concrete		600			
Cement		14,500			
STUDY AREA	232,400	36,800	44,400	6,500	900

TABLE 13 HYDROCARBON EMISSIONS FROM EVAPORATIVE LOSSES IN THE
SALT LAKE CITY, PROVO AND OGDEN STUDY AREA, 1968
(TONS/YEAR)

	Hydrocarbons
Dry Cleaning Plants	1,800
Automobile	9,300
Gasoline Storage and Handling	200
STUDY AREA	11,300

EMISSIONS BY JURISDICTION

The previous section presented air pollutant emissions by source category. In order to show the contribution of each county to the air pollution in the Study Area, their emissions are summarized in Tables 14 through 20.

TABLE 14 SUMMARY OF AIR POLLUTANT EMISSIONS IN BOX ELDER
COUNTY, 1968 (TONS/YEAR)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Road Vehicles	50	50	7,800	650	450
Other	100	150	100	150	300
Total	150	200	7,900	800	750
Fuel Combustion in Stationary Sources					
Industry	0	0	0	0	100
Steam-Electric	0	0	0	0	0
Residential	50	50	100	0	50
Commercial- Institutional	200	300	450	100	100
Total	250	350	550	100	250
Solid Waste Disposal					
Incineration	0	0	0	0	0
Open Burning	50	400	2,250	800	300
Total	50	400	2,250	800	300
Industrial Processes	0	0	0	0	0
Evaporative Losses	--	--	--	550	--
STUDY AREA	450	950	10,700	2,250	1,300

TABLE 15 SUMMARY OF AIR POLLUTANT EMISSIONS IN CACHE COUNTY,
1968 (TONS/YEAR)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Road Vehicles	50	100	9,950	800	600
Other	150	200	100	200	350
Total	200	300	10,050	1,000	950
Fuel Combustion in Stationary Sources					
Industry	0	0	0	0	150
Steam-Electric	0	0	0	0	0
Residential	100	50	200	50	100
Commercial- Institutional	300	450	650	150	150
Total	400	500	850	200	400
Solid Waste Disposal					
Incineration	0	0	0	0	0
Open Burning	50	650	3,400	1,200	450
Total	50	650	3,400	1,200	450
Industrial Processes	0	0	0	0	0
Evaporative Losses	--	--	--	700	--
STUDY AREA	650	1,450	14,300	3,100	1,800

TABLE 16 SUMMARY OF AIR POLLUTANT EMISSIONS IN DAVIS
COUNTY, 1968 (TONS/YEAR)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Road Vehicles	50	100	11,350	900	700
Other	250	300	150	400	650
Total	300	400	11,500	1,300	1,350
Fuel Combustion in Stationary Sources					
Industry	2,750	100	0	0	750
Steam-Electric	200	250	0	0	200
Residential	50	50	50	0	200
Commercial- Institutional	200	350	400	100	350
Total	3,200	750	450	100	1,500
Solid Waste Disposal					
Incineration	50	150	550	0	50
Open Burning	50	1,200	6,300	2,200	800
Total	100	1,350	6,850	2,200	850
Industrial Processes	0	100	0	3,800	200
Evaporative Losses	--	--	--	750	--
STUDY AREA	3,600	2,600	18,800	4,350	3,900

TABLE 17 SUMMARY OF AIR POLLUTANT EMISSIONS IN SALT LAKE COUNTY
1968 (TONS/YEAR)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Road Vehicles	500	950	97,800	7,950	5,900
Other	1,400	1,850	7,500	3,600	4,000
Total	1,900	2,800	105,300	11,550	9,900
Fuel Combustion in Stationary Sources					
Industry	3,650	1,550	50	0	8,900
Steam-Electric	10,250	1,100	0	100	4,500
Residential	350	350	500	100	1,100
Commercial- Institutional	1,000	1,600	2,100	400	1,150
Total	15,250	4,600	2,650	600	15,650
Solid Waste Disposal					
Incineration	250	1,200	5,300	100	350
Open Burning	150	2,400	12,750	4,500	1,650
Total	400	3,600	18,050	4,600	2,000
Industrial Processes	198,550	17,650	2,750	2,650	200
Evaporative Losses	--	--	--	5,800	--
STUDY AREA	216,100	28,650	128,750	25,200	27,750

TABLE 18 SUMMARY OF AIR POLLUTANT EMISSIONS IN TOOELE COUNTY
1968 (TONS/YEAR)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Road Vehicles	50	50	5,600	450	350
Other	100	100	50	150	200
Total	150	150	5,650	600	550
Fuel Combustion in Stationary Sources					
Industry	0	0	0	0	100
Steam-Electric	0	0	0	0	0
Residential	0	0	0	0	50
Commercial- Institutional	100	100	150	50	100
Total	100	100	150	50	250
Solid Waste Disposal					
Incineration	0	0	0	0	0
Open Burning	0	350	1,750	600	250
Total	0	350	1,750	600	250
Industrial Processes	32,100	1,000	23,000	0	0
Evaporative Losses	--	--	--	300	--
STUDY AREA	32,350	1,600	30,550	1,550	1,050

TABLE 19 SUMMARY OF AIR POLLUTANT EMISSIONS IN UTAH COUNTY
1968 (TONS/YEAR)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Road Vehicles	150	250	27,250	2,200	1,650
Other	400	600	2,150	950	1,150
Total	550	850	29,400	3,150	2,800
Fuel Combustion in Stationary Sources					
Industry	2,500	0	0	0	250
Steam-Electric	200	0	0	0	0
Residential	200	100	150	50	300
Commercial- Institutional	650	400	550	100	250
Total	3,550	500	700	150	800
Solid Waste Disposal					
Incineration	150	1,150	1,250	50	200
Open Burning	50	600	3,300	1,150	450
Total	200	1,750	4,550	1,200	650
Industrial Processes	0	250	0	0	0
Evaporative Losses	--	--	--	1,550	--
STUDY AREA	4,300	3,350	34,650	6,050	4,250

TABLE 20 SUMMARY OF AIR POLLUTANT EMISSIONS IN WEBER COUNTY
1968 (TONS/YEAR)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Road Vehicles	150	250	25,650	2,100	1,550
Other	450	550	300	700	1,150
Total	600	800	25,950	2,800	2,700
Fuel Combustion in Stationary Sources					
Industry	0	0	0	0	250
Steam-Electric	0	0	0	0	0
Residential	100	100	150	50	300
Commercial- Institutional	250	400	550	100	250
Total	350	500	700	150	800
Solid Waste Disposal					
Incineration	150	1,150	1,250	50	200
Open Burning	50	600	3,300	1,150	450
Total	200	1,750	4,550	1,200	650
Industrial Processes	0	250	0	0	0
Evaporative Losses	--	--	--	1,550	--
STUDY AREA	1,150	3,300	31,200	5,700	4,150

EMISSIONS BY GRID

For the purpose of defining the geographical variation in air pollutant emissions in the Study Area, the emissions were apportioned onto a grid coordinate system. The emissions were divided into two source groups--point sources and area sources. Thirty-one point sources are presented individually in Table 21. Each of these point sources emitted more than 0.25 tons per day of a pollutant. The approximate location of these point sources are shown in Figure 5. Area sources which made up the balance of emissions have not been presented separately, but have been combined with the point source emissions and presented with emissions from all sources in Table 22.

In order to present a visual representation of the emissions of pollutants by grid, emission density maps have been prepared. Emission densities were obtained by summing the annual area and point source emissions for each grid and dividing this total by the land area of the grid. Figures 6 through 10 show the variation in emission densities for the respective grids throughout the Study Area.

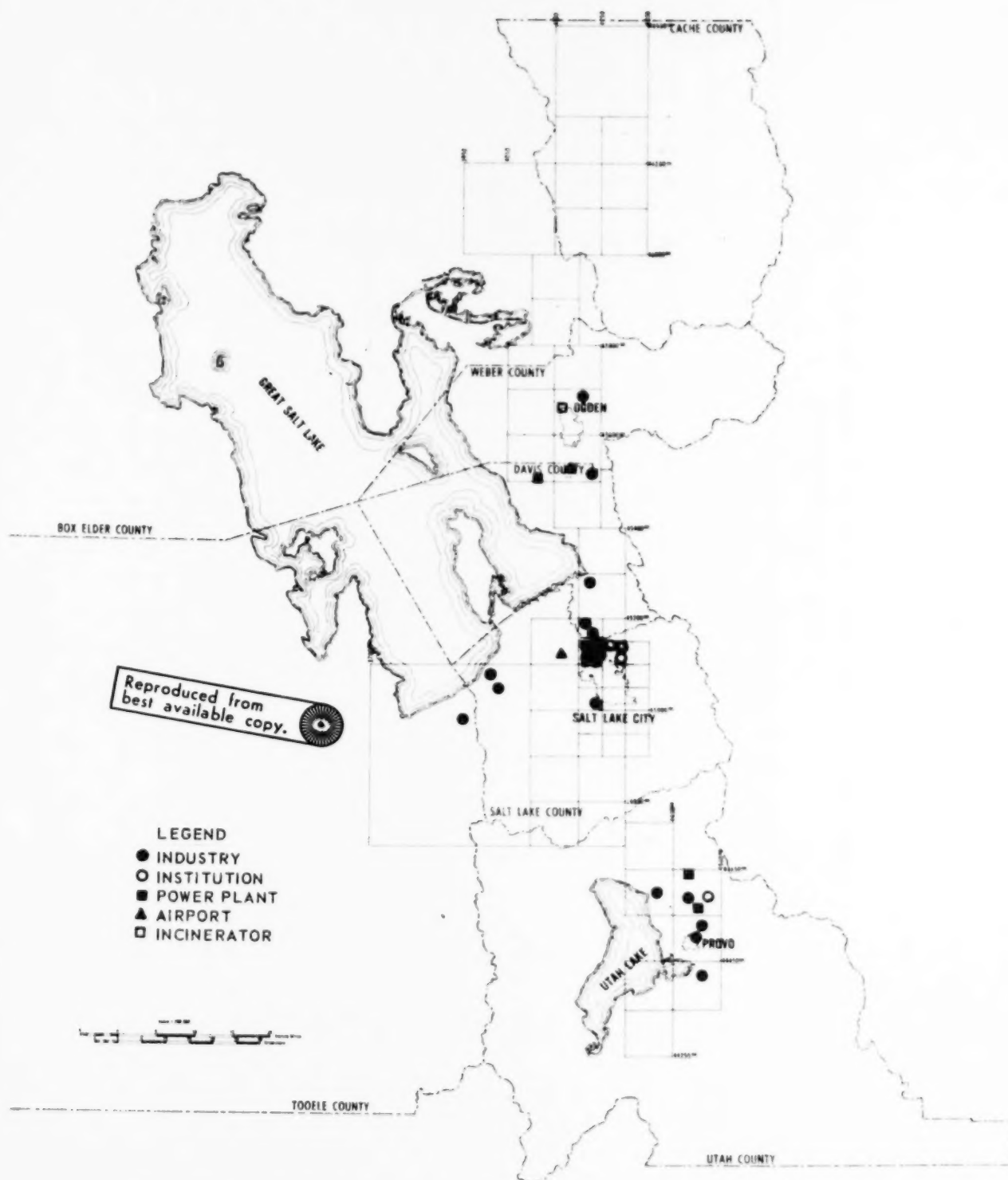


Figure 5. Point source location map for Salt Lake City, Provo and Ogden study area.

TABLE 21 SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINT SOURCES FOR THE SALT LAKE CITY,
PROVO AND OGDEN STUDY AREA

Source Category	Grid	HC (100)		VC (100)		SOx		PART.		CO		HC		NOx	
		A	S	A	S	A	S	A	S	A	S	A	S	A	S
Industry	14	4210	45680	0.0	0.0	0.0	0.0	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incinerator	14	4165	45640	0.2	0.2	2.32	2.32	2.32	0.13	0.13	0.04	0.04	0.04	0.27	0.27
Power Plant	15	4110	45515	0.2	0.8	0.64	0.94	0.64	0.00	0.01	0.00	0.00	0.00	0.16	0.66
Industry	16	4240	45520	0.0	0.0	0.25	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Institution	16	4175	45530	0.0	0.1	0.00	0.16	0.00	0.00	0.13	0.06	0.00	0.02	0.03	0.76
Airport	16	4175	45530	0.0	0.0	0.23	0.23	0.23	5.10	5.10	0.95	0.95	0.95	0.36	0.36
Industry	19	4240	45270	4.1	4.1	0.03	0.03	0.03	0.00	0.00	0.00	3.36	3.36	0.58	0.62
Airport	20	4180	45110	0.0	0.0	0.28	0.28	0.28	17.95	17.95	4.06	4.06	4.06	1.07	1.07
Industry	21	4220	45195	3.3	3.4	0.18	0.21	0.19	0.00	0.01	0.00	7.09	7.09	1.88	2.05
Industry	21	4230	45165	7.3	7.6	0.33	0.37	0.35	0.02	0.03	0.02	6.05	6.05	1.85	2.00
Industry	23	4220	45145	0.0	0.0	0.01	0.01	0.01	0.00	0.00	0.00	1.04	1.04	0.18	0.20
Industry	23	4235	45116	0.0	0.0	0.48	0.48	0.48	6.90	6.90	0.00	0.00	0.00	0.00	0.00
Industry	23	4238	45148	0.0	0.0	0.04	0.04	0.04	0.51	0.51	0.00	0.00	0.00	0.00	0.00
Industry	23	4233	45112	0.0	0.0	48.02	11.93	39.62	0.00	0.00	0.00	0.00	0.00	0.24	0.30
Power Plants	23	4212	45130	27.8	27.8	0.96	0.96	0.94	0.00	0.00	0.00	0.26	0.26	11.81	11.81
Power Plants	23	4240	45135	0.0	1.2	0.00	4.04	1.99	0.00	0.02	0.01	0.00	0.01	0.00	1.09
Institution	24	4290	45125	0.0	0.5	0.06	1.28	0.64	0.05	1.10	0.55	0.01	0.22	0.11	0.33
Institution	24	4255	45145	0.0	0.6	0.04	0.39	0.20	0.14	1.37	0.72	0.02	0.27	0.14	0.02
Institution	24	4290	45130	0.0	0.3	0.06	0.59	0.31	0.08	0.84	0.44	0.01	0.16	0.08	0.01
Industry	30	4243	45018	0.0	0.0	8.44	0.00	5.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 21 SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINT SOURCES (cont.)

Source Category	Grid	HC	VC	SOx		A	S	PART.		A	S	CO		A	S	HC		A	S	NOx	
				W	S			W	S			W	S			W	S			W	S
Industry	45	4370	44590	9.6	10.2	9.9	49.27	49.40	49.33	0.08	0.09	0.08	0.07	0.06	0.06	0.07	0.06	0.06	0.06	8.25	9.01
Industry	46	4430	44570	0.0	0.2	0.1	0.00	3.56	1.68	0.00	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.32
Institution	46	4460	44570	0.0	1.7	0.8	0.04	0.97	0.48	0.18	3.80	1.89	0.03	0.76	0.37	0.03	0.61	0.30	0.30	0.30	0.30
Power Plant	46	4450	44560	0.2	0.6	0.5	0.35	0.83	0.62	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.26	0.61	0.45	0.45	0.45
Power Plant	46	4440	44630	0.0	0.0	0.0	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.05	0.29	0.29	0.29
Industry	47	4460	44510	0.0	0.0	0.0	0.72	0.51	0.61	59.99	42.49	51.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industry	47	4460	44535	0.0	0.0	0.0	0.49	0.24	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industry	49	4450	44410	0.0	0.0	0.0	0.03	0.03	0.03	0.45	0.45	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industry	51	4000	45090544.6	544.6	544.6	544.6	9.18	9.26	9.22	0.08	0.09	0.09	0.02	0.02	0.02	0.02	6.62	6.91	6.76	6.76	6.76
Industry	51	4025	45025	0.0	0.1	0.1	0.05	0.07	0.06	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.22	0.33	0.27	0.27	0.27
Industry	51	3960	44875	88.0	88.0	88.0	2.69	2.69	2.69	63.00	63.00	63.00	0.00	0.00	0.00	0.00	0.20	0.23	0.21	0.21	0.21

TABLE 22
SUMMARY OF AIR POLLUTANT EMISSIONS FROM ALL SOURCES FOR THE SALT LAKE CITY,
PROVO AND OGDEN STUDY AREA

Grid	Land Area (Sq. Mi.)	SOx		PART.		CO		HC		NOx				
		S	W	A	S	W	A	S	W	A	S	W		
1	154.4	0.1	0.6	0.3	0.5	1.1	0.8	8.3	7.6	1.7	1.6	0.8	1.0	0.9
2	38.6	0.0	0.0	0.0	0.2	0.2	0.2	1.2	1.2	0.4	0.4	0.1	0.1	0.1
3	38.6	0.2	1.3	0.7	0.6	2.0	1.3	17.7	16.1	3.1	3.0	1.6	2.1	1.8
4	154.4	0.2	0.7	0.4	0.6	1.4	1.0	11.7	10.5	2.3	2.2	1.1	1.3	1.2
5	38.6	0.0	0.1	0.1	0.2	0.3	0.3	2.3	2.2	0.6	0.5	0.2	0.3	0.2
6	38.6	0.1	0.7	0.4	0.5	1.2	0.8	9.4	8.6	1.9	1.8	1.0	1.2	1.1
7	38.6	0.1	0.1	0.1	0.3	0.3	0.3	1.3	1.3	0.5	0.5	0.3	0.3	0.3
8	38.6	0.1	0.2	0.1	0.3	0.4	0.3	2.0	1.9	0.6	0.6	0.4	0.5	0.4
9	38.6	0.2	1.1	0.6	0.8	2.0	1.4	17.6	15.8	3.3	3.2	1.7	2.0	1.8
10	38.6	0.1	0.2	0.2	0.4	0.5	0.4	2.6	2.5	0.8	0.8	0.6	0.6	0.6
11	38.6	0.0	0.0	0.0	0.1	0.2	0.2	1.8	1.6	0.4	0.4	0.2	0.2	0.2
12	38.6	0.1	0.1	0.1	0.3	0.4	0.4	6.9	5.7	1.2	1.0	0.6	0.6	0.6
13	38.6	0.3	0.4	0.4	0.6	0.7	0.7	5.5	4.5	1.4	1.3	1.2	1.2	1.2
14	38.6	1.1	2.8	1.9	6.3	6.7	6.3	67.6	55.5	10.4	9.0	6.1	7.2	6.4
15	38.6	0.8	1.9	1.4	1.9	3.2	2.5	19.1	16.5	4.3	4.0	2.8	3.8	3.3
16	38.6	0.6	0.9	0.7	1.9	2.5	2.2	19.7	17.7	4.5	4.3	2.7	3.7	3.2
17	38.6	0.3	0.6	0.4	1.0	1.5	1.3	12.8	11.2	2.8	2.6	1.4	2.0	1.7
18	38.6	0.2	0.3	0.2	0.7	0.9	0.8	5.6	5.1	1.5	1.5	0.9	1.1	1.0
19	38.6	4.4	5.0	4.7	1.5	2.3	1.9	20.6	17.9	7.4	7.2	2.8	3.9	3.2
20	38.6	0.1	0.1	0.1	0.8	0.8	0.8	22.4	21.8	4.8	4.8	1.4	1.5	1.4
21	9.6	11.1	11.8	11.5	0.9	1.2	1.0	14.0	11.0	15.2	14.9	15.0	5.4	5.0

TABLE 22 SUMMARY OF AIR POLLUTANT EMISSIONS (cont.)

Grid	Land Area (Sq. Mi.)	SOx		PART.		CO		HC		NOx	
		S	W	A	S	W	A	S	W	A	W
22	9.6	0.0	0.0	0.0	0.2	0.2	1.8	0.5	0.5	0.5	0.2
23	9.6	29.5	31.8	30.2	52.1	21.1	46.2	9.3	8.3	8.6	20.0
24	9.6	0.8	3.2	1.9	2.4	5.7	4.0	7.5	7.0	7.0	5.4
25	9.6	0.0	0.1	0.0	0.2	0.3	0.2	0.7	0.6	0.6	0.3
26	38.6	1.1	1.4	1.2	1.9	2.4	2.1	5.5	4.9	5.1	4.6
27	9.6	0.3	0.9	0.6	0.9	1.6	1.2	4.1	3.4	3.6	2.2
28	9.6	0.7	1.9	1.2	2.1	3.6	2.8	9.0	7.6	8.0	5.5
29	9.6	0.1	0.4	0.2	0.6	0.9	0.7	2.2	1.9	2.0	1.2
30	9.6	1.1	1.3	1.2	10.1	1.5	2.3	3.5	3.2	3.3	3.6
31	9.6	0.2	0.5	0.3	0.6	1.0	0.8	3.5	2.9	3.1	1.9
32	9.6	0.1	0.2	0.1	0.4	0.6	0.5	1.9	1.6	1.7	1.0
33	38.6	0.1	0.2	0.1	0.4	0.6	0.5	1.9	1.6	1.7	1.0
34	9.6	1.1	1.3	1.2	1.6	1.8	1.7	3.5	3.2	3.3	3.6
35	9.6	0.1	0.3	0.2	0.4	0.6	0.5	1.8	1.5	1.6	1.0
36	9.6	0.0	0.1	0.1	0.2	0.3	0.3	0.9	0.8	0.8	0.5
37	9.6	0.0	0.1	0.1	0.2	0.3	0.3	0.8	0.8	0.8	0.4
38	9.6	0.0	0.1	0.1	0.3	0.4	0.3	1.1	0.9	1.0	0.5
39	9.6	0.0	0.1	0.1	0.2	0.3	0.2	0.7	0.6	0.6	0.3
40	38.6	0.0	0.1	0.0	0.2	0.3	0.3	0.7	0.7	0.7	0.3
41	38.6	0.0	0.1	0.1	0.2	0.3	0.3	0.9	0.8	0.9	0.5
42	38.6	0.1	0.1	0.1	0.7	0.8	0.7	1.5	1.5	1.5	0.6
43	38.6	0.1	0.2	0.1	0.8	0.9	0.9	1.9	1.9	1.9	1.0
44	23.1	0.2	0.7	0.4	0.9	1.3	1.1	2.8	2.6	2.6	1.6

TABLE 22 SUMMARY OF AIR POLLUTANT EMISSIONS (cont.)

Grid	Land Area (Sq. Mi.)	SOx		PART.		CO		HC		NOx						
		S	W	A	S	W	A	S	W	A	S	W	A			
45	38.6	10.2	11.5	10.8	50.4	51.2	50.7	21.3	17.7	18.7	3.7	3.3	3.4	10.5	11.7	11.0
46	38.6	1.0	4.5	2.6	1.5	7.6	4.4	35.3	32.9	32.6	5.5	5.5	5.3	3.5	36.1	18.8
47	30.8	0.7	1.1	0.9	1.9	1.8	1.8	70.2	51.0	60.2	2.0	1.8	1.8	1.7	2.0	1.8
48	38.6	0.3	0.4	0.3	0.1	0.1	0.1	1.0	0.8	0.9	0.2	0.1	0.1	0.3	0.4	0.3
49	38.6	0.5	0.8	0.6	1.1	1.3	1.2	10.3	9.1	9.4	2.4	2.3	2.3	1.6	1.8	1.7
50	38.6	0.4	0.6	0.5	1.1	1.4	1.2	11.8	10.3	10.7	2.7	2.6	2.6	1.6	1.8	1.7
51	617.7	633.2	634.0	633.6	13.6	14.5	14.0	92.6	87.7	89.2	5.7	5.2	5.3	10.3	11.3	10.7

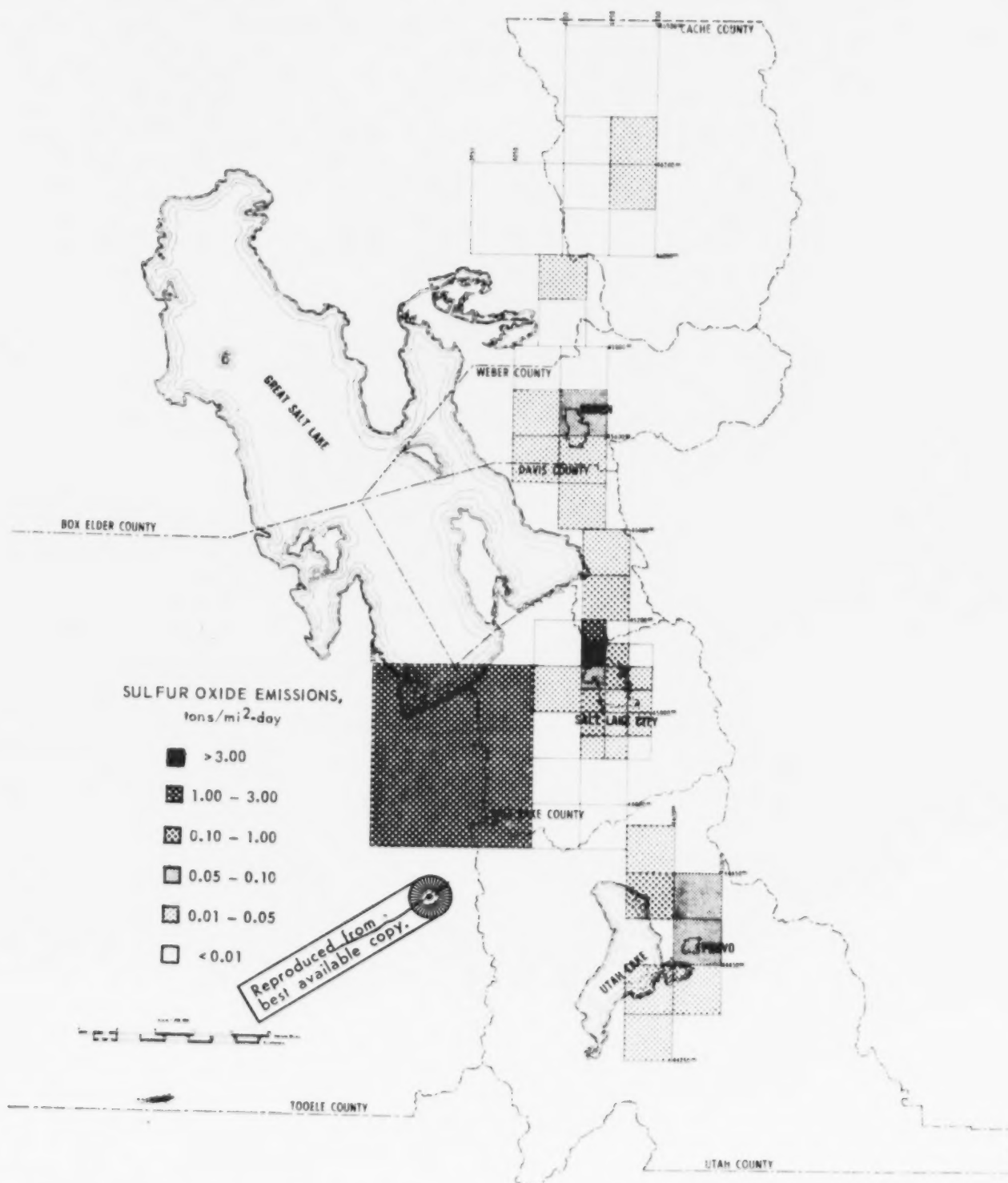


Figure 6. Sulfur oxide emission density map for the Salt Lake City Provo, and Ogden study area.

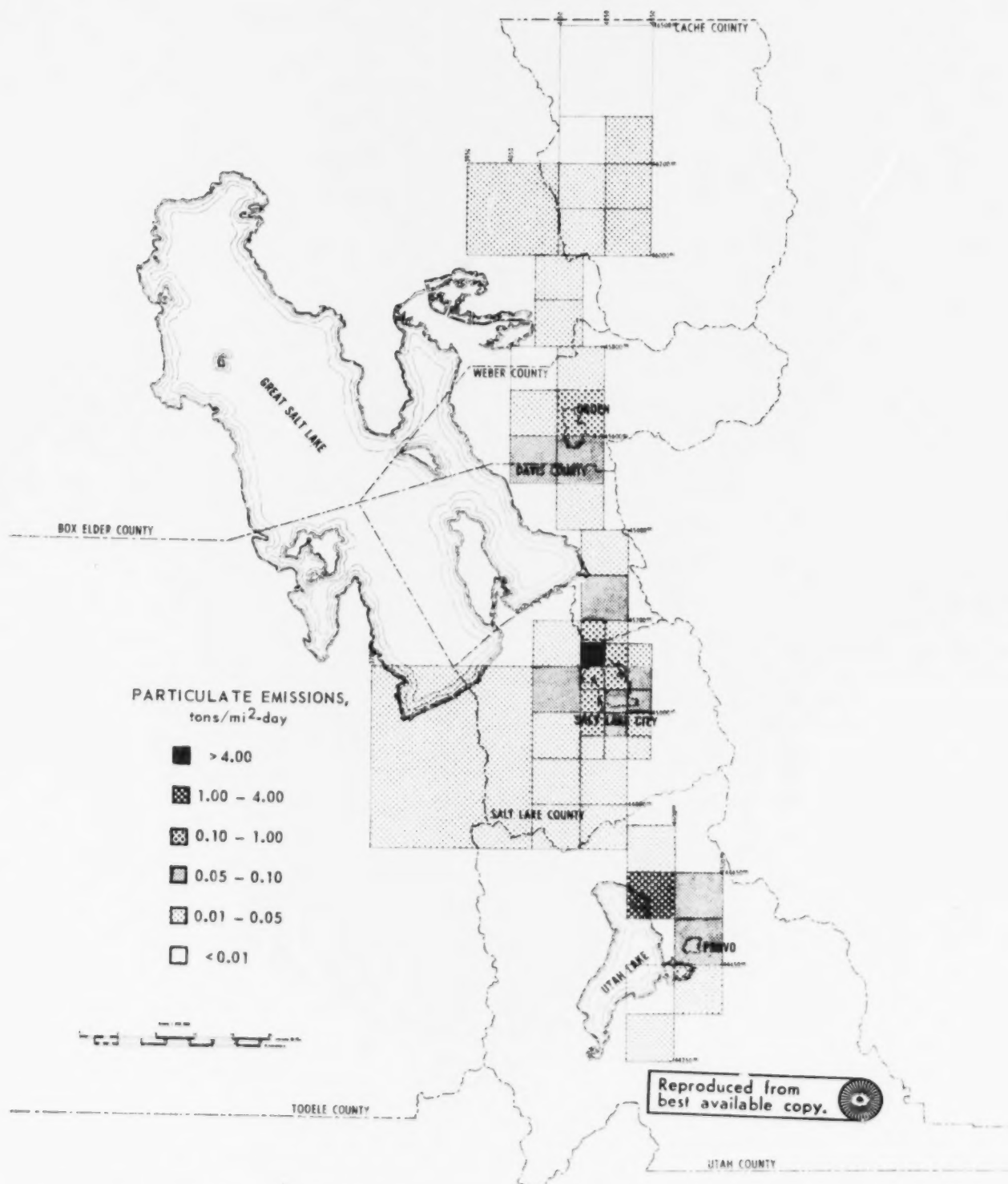


Figure 7. Particulate emission density map for the Salt Lake City, Provo, and Ogden study area.

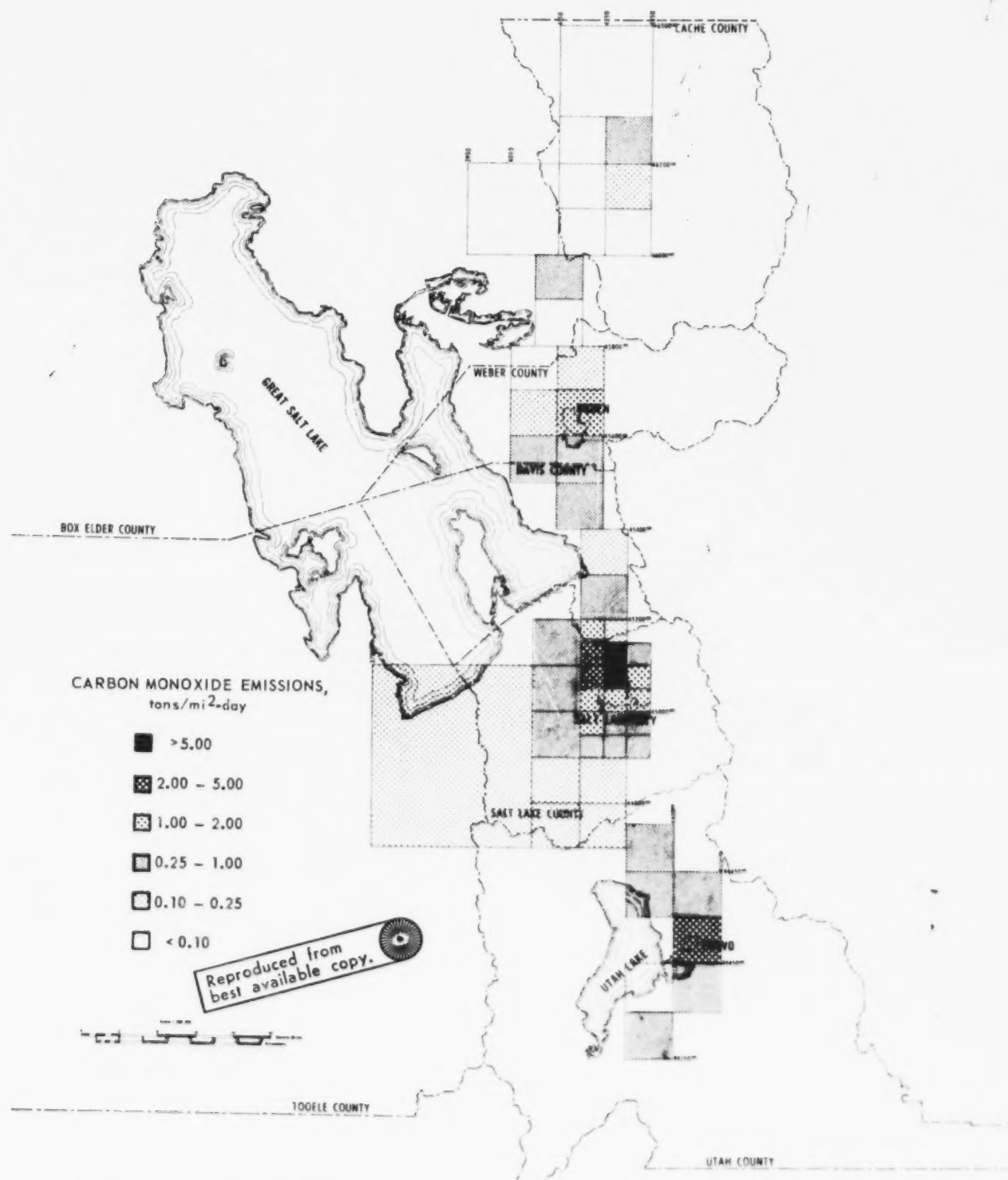


Figure 8. Carbon monoxide emission density map for the Salt Lake City, Provo, and Ogden study area.

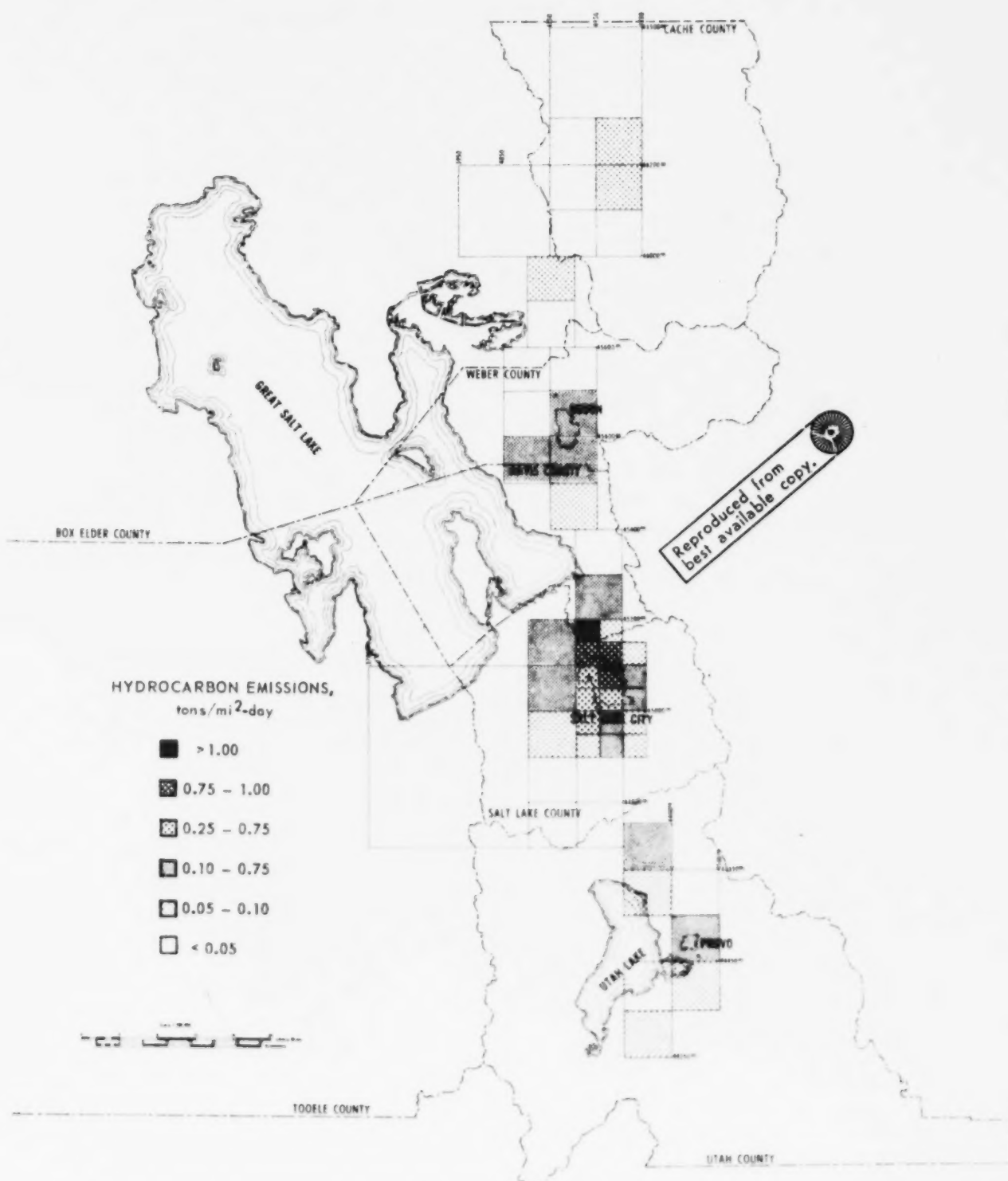


Figure 9. Hydrocarbon emission density map for the Salt Lake City, Provo, and Ogden study area.

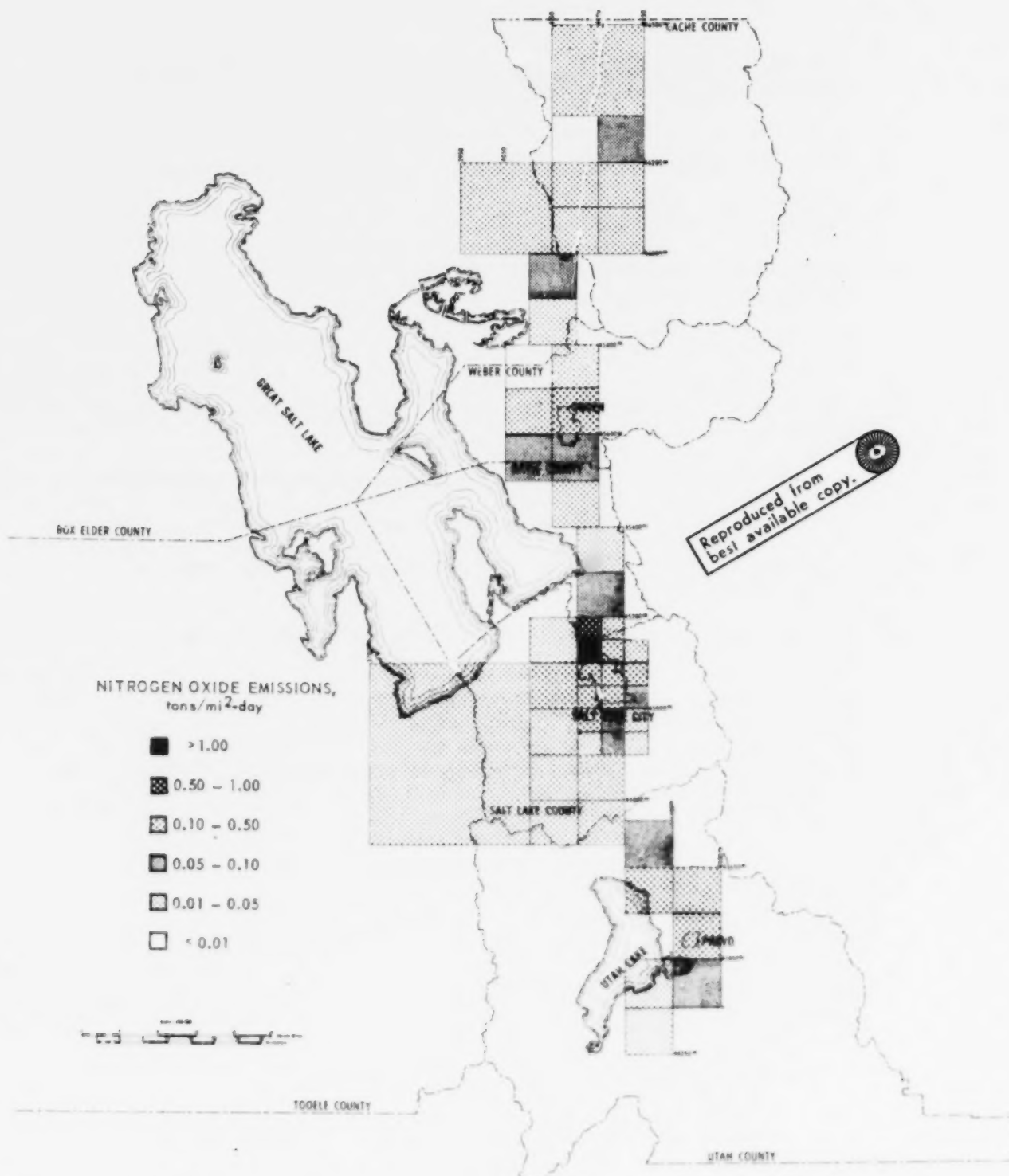


Figure 10. Nitrogen oxide emission density map for the Salt Lake City, Provo, and Ogden study area.

REFERENCES

1. Ozolins, G. and Smith, R., Rapid Survey Technique for Estimating Community Air Pollution, DHEW, PHS, October 1966.
2. Duprey, R. L., Compilation of Air Pollution Emission Factors, DHEW, PHS, April 1967.
3. United States Census of Housing: 1960 - Utah, United States Department of Commerce, Bureau of the Census.
4. United States Census of Population: 1960 - Utah, United States Department of Commerce, Bureau of the Census.
5. Vehicle Miles on Utah Highways, Utah State Department of Highways, 1968.
6. 1963 Census of Business: Retail Trade, United States Department of Commerce, Bureau of the Census.
7. Highway Statistics/1968, United States Department of Transportation.
8. Petroleum Facts and Figures, American Petroleum Institute.
9. 1968 National Survey of Community Solid Waste Practice, Interim Report, DHEW, PHS.
10. Personal Communication with Utah Division of Health, Air Quality Section.
11. Mineral Industry Surveys, Burner Fuel Oils, 1967, United States Department of Interior, Bureau of Mines.
12. National Air Pollution Control Administration Reference Book of Nation Wide Emissions, 1968.